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JC13 Rec'd PCT/PTO 22 OCT 2001

FORM PTO-1390 (Modified) (REV 11-2000) U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE

TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371

ATTORNEY'S DOCKET NUMBER: 112740-349

U.S. APPLICATION NO. (IF KNOWN, SEE 37 CFR: 10/030375

INTERNATIONAL APPLICATION NO.	INTERNATIONAL FILING DATE	PRIORITY DATE CLAIMED
PCT/DE00/01203	17 April 2000	20 April 1999

TITLE OF INVENTION

APPARATUS AND METHOD FOR IMPROVING LOAD DISTRIBUTION IN A SIGNALING NETWORK

APPLICANT(S) FOR DO/EO/US

Claus Friedl

Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:

1. ☒ This is a **FIRST** submission of items concerning a filing under 35 U.S.C. 371.
2. ☐ This is a **SECOND** or **SUBSEQUENT** submission of items concerning a filing under 35 U.S.C. 371.
3. ☒ This is an express request to begin national examination procedures (35 U.S.C. 371(f)). The submission must include itens (5), (6), (9) and (24) indicated below.
4. ☒ The US has been elected by the expiration of 19 months from the priority date (Article 31).
5. ☒ A copy of the International Application as filed (35 U.S.C. 371 (c) (2))
   a. ☒ is attached hereto (required only if not communicated by the International Bureau).
   b. ☐ has been communicated by the International Bureau.
   c. ☐ is not required, as the application was filed in the United States Receiving Office (RO/US).
6. ☒ An English language translation of the International Application as filed (35 U.S.C. 371(c)(2)).
   a. ☒ is attached hereto.
   b. ☐ has been previously submitted under 35 U.S.C. 154(d)(4).
7. ☒ Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371 (c)(3))
   a. ☒ are attached hereto (required only if not communicated by the International Bureau).
   b. ☐ have been communicated by the International Bureau.
   c. ☐ have not been made; however, the time limit for making such amendments has NOT expired.
   d. ☐ have not been made and will not be made.
8. ☒ An English language translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).
9. ☒ An oath or declaration of the inventor(s) (35 U.S.C. 371 (c)(4)).
10. ☐ An English language translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371 (c)(5)).
11. ☒ A copy of the International Preliminary Examination Report (PCT/IPEA/409).
12. ☒ A copy of the International Search Report (PCT/ISA/210).

Items 13 to 20 below concern document(s) or information included:

13. ☒ An Information Disclosure Statement under 37 CFR 1.97 and 1.98.
14. ☒ An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.
15. ☒ A **FIRST** preliminary amendment.
16. ☐ A **SECOND** or **SUBSEQUENT** preliminary amendment.
17. ☒ A substitute specification.
18. ☐ A change of power of attorney and/or address letter.
19. ☐ A computer-readable form of the sequence listing in accordance with PCT Rule 13ter.2 and 35 U.S.C. 1.821 - 1.825.
20. ☐ A second copy of the published international application under 35 U.S.C. 154(d)(4).
21. ☐ A second copy of the English language translation of the international application under 35 U.S.C. 154(d)(4).
22. ☒ Certificate of Mailing by Express Mail
23. ☐ Other items or information:

JC10 Rec'd PCT/PTO 22 OCT 2001

U.S. APPLICATION NO. (IF KNOWN, SEE 37 CFR 10/030375	INTERNATIONAL APPLICATION NO. PCT/DE00/01203	ATTORNEY'S DOCKET NUMBER 112740-349

24. The following fees are submitted:.

BASIC NATIONAL FEE (37 CFR 1.492 (a) (1) - (5)) :

		CALCULATIONS	PTO USE ONLY
☐ Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(2)) paid to USPTO and International Search Report not prepared by the EPO or JPO	$1040.00		
☒ International preliminary examination fee (37 CFR 1.482) not paid to USPTO but International Search Report prepared by the EPO or JPO	$890.00		
☐ International preliminary examination fee (37 CFR 1.482) not paid to USPTO but international search fee (37 CFR 1.445(a)(2)) paid to USPTO	$740.00		
☐ International preliminary examination fee (37 CFR 1.482) paid to USPTO but all claims did not satisfy provisions of PCT Article 33(1)-(4)	$710.00		
☐ International preliminary examination fee (37 CFR 1.482) paid to USPTO and all claims satisfied provisions of PCT Article 33(1)-(4)	$100.00		
ENTER APPROPRIATE BASIC FEE AMOUNT =		$890.00	
Surcharge of **$130.00** for furnishing the oath or declaration later than ☐ 20 ☐ 30 months from the earliest claimed priority date (37 CFR 1.492 (e)).		$0.00	

CLAIMS	NUMBER FILED	NUMBER EXTRA	RATE	CALCULATIONS	PTO USE ONLY
Total claims	12 - 20 =	0	x $18.00	$0.00	
Independent claims	2 - 3 =	0	x $84.00	$0.00	
Multiple Dependent Claims **(check if applicable).**			☐	$0.00	
TOTAL OF ABOVE CALCULATIONS =				$890.00	
☐ Applicant claims small entity status. See 37 CFR 1.27). The fees indicated above are reduced by 1/2.				$0.00	
SUBTOTAL =				$890.00	
Processing fee of **$130.00** for furnishing the English translation later than ☐ 20 ☐ 30 months from the earliest claimed priority date (37 CFR 1.492 (f)). +				$0.00	
TOTAL NATIONAL FEE =				$890.00	
Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31) **(check if applicable).** ☐				$0.00	
TOTAL FEES ENCLOSED =				$890.00	
				Amount to be: refunded	$
				charged	$

a. ☒ A check in the amount of **$890.00** to cover the above fees is enclosed.

b. ☐ Please charge my Deposit Account No. ______ in the amount of ______ to cover the above fees. A duplicate copy of this sheet is enclosed.

c. ☒ The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. **02-1818** A duplicate copy of this sheet is enclosed.

d. ☐ Fees are to be charged to a credit card. **WARNING:** Information on this form may become public. **Credit card information should not be included on this form.** Provide credit card information and authorization on PTO-2038.

NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.

SEND ALL CORRESPONDENCE TO:

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39,056
REGISTRATION NUMBER

October 22, 2001
DATE

BOX PCT

IN THE UNITED STATES ELECTED/DESIGNATED OFFICE
OF THE UNITED STATES PATENT AND TRADEMARK OFFICE
UNDER THE PATENT COOPERATION TREATY-CHAPTER II

PRELIMINARY AMENDMENT

APPLICANT:	Claus Friedl	DOCKET NO.:	112740-349
SERIAL NO:		GROUP ART UNIT:	
FILED:		EXAMINER:	
INTERNATIONAL APPLICATION NO::		PCT/DE00/01203	
INTERNATIONAL FILING DATE		17 April 2000	
INVENTION:	APPARATUS AND METHOD FOR IMPROVING LOAD DISTRIBUTION IN A SIGNALING NETWORK		

Assistant Commissioner for Patents,
Washington, D.C. 20231

Sir:

Please amend the above-identified International Application before entry into the National stage before the U.S. Patent and Trademark Office under 35 U.S.C. §371 as follows:

In the Specification:

Please replace the Specification of the present application, including the Abstract, with the following Substitute Specification:

SPECIFICATION

TITLE OF INVENTION

APPARATUS AND METHOD FOR IMPROVING
LOAD DISTRIBUTION IN A SIGNALING NETWORK

BACKGROUND OF THE INVENTION

The present invention relates to an apparatus and a method for improving the load distribution in a signaling network and, in particular, to what is referred to

as a load sharing method which results in signaling data being distributed uniformly in a digital signaling network.

Communication nets or networks generally connect two subscriber terminals to one another via a number of line sections and switching devices in order to interchange messages (for example, voice, data, text and/or images). Control information and signaling messages can, in this case, be transmitted between the switching centers, for connection control and when using service features. Digital, computer-controlled communication networks, in particular, offer a considerably greater performance scope in comparison to analog communication networks, for which reason a new, powerful signaling system has been introduced in digital, computer-controlled communication networks.

The ITU (International Telecommunication Union) has thus specified the central signaling system No. 7 (CCS7), which is optimized for use in digital nets or networks.

In contrast to the previously normal channel-based signaling, the signaling messages in CCS7 are passed via separate signaling paths or signaling channels (links). A large number of such signaling channels (links) in this case form what is referred to as a signaling set (link set), which has a maximum of 16 signaling channels (links). A signaling channel transports the signaling messages for a number of user channels (trunks).

The signaling channels or signaling links (links or link sets) in CCS7 connect what are referred to as message transfer parts (MTP) in a communication network. The message transfer parts and the signaling channels thus form an autonomous signaling network which is superimposed on a user channel network.

The signaling end points are, in this case, the sources and sinks of the signaling traffic and are provided in a communication network primarily by switching centers or signaling nodes. In this case, the message transfer parts (MTP) transmit received signaling messages on the basis of a destination address (destination point code, DPC) to another message transfer part (MTP). No switching processing of the signaling messages is generally carried out in a message transfer part (MTP). A message transfer part may be integrated in a

signaling end point (for example, a switching center), or may form an autonomous signaling node in the signaling network. One or more levels of message transfer parts (MTP) may be possible depending on the size of the signaling network.

All the signaling points in a predetermined signaling network are identified within a numbering plan, which is defined by the ITU via, for example, a 14-point code (PC) and thus can be addressed specifically in a signaling message. In CCS7, such a signaling message is provided by the message signaling unit MSU).

In addition to a destination address (destination point code DPC) and a source address (origin point code OPC), a speech circuit address (circuit identification code CIC) is also stored in these signaling messages, which are transmitted in the signaling network, and message signaling units (MSU). This voice circuit address (CIC) has 12 bits according to the ITU Standard, with the 4 least-significant bits being referred to as a signaling path selection field (signaling link selection field, SLS). According to the ITU, the various voice signaling messages (MSU) are assigned predetermined signaling paths via this signaling path selection field (SLS values).

In a conventional signaling network, the signaling messages (MSU) to be transmitted are distributed uniformly between the available signaling channels (or active links in a signaling set of its link set) thus allowing the load to be distributed uniformly in the signaling network.

Such a conventional load distribution method is known from the reference "Wang J. L: A Novel Link Set Dimensioning Procedure for Networks supporting the Load Splitting Link Selection Algorithm, Proceedings to the Infocom '93 Annual Joint Conference of the computer and communications societies Conference Proceedings Vol. 12, March 28, 1993 – April 1, 1993, pages 1280 – 1287". This proposes a novel signaling set dimensioning method which is based on the "load splitting link selection" algorithm, in which randomly produced bit patterns are used for selecting a signaling channel. The capacity and available individual bandwidth in these signaling channels are, however, regarded as being essentially equivalent in this method. In order to improve the load distribution, particularly in cases where the increase in the total capacity in the signaling set

(link set) is inadequate despite the addition of additional signaling channels, this document proposes a theorem for creating a special set of equivalent signaling channels via which the actually available total capacity is used optimally, especially when using the "load splitting link selection" algorithm.

Particularly when using novel transmission techniques such as packet switching, ATM, IP etc., and a result of the use of novel transmission media, such as glass fiber cables, signaling configurations have increasingly arisen in which signaling channels occur with different bandwidths; that is, transmission rates for the signaling messages (MSU).

Such a method and an apparatus for providing load distribution in a signaling network having a large number of signaling nodes for distribution of signaling messages, and a large number of signaling channels for transmitting signaling messages, are known from the reference "Franz R. et al.: ATM-Based SS7 for Narrowband Networks – A step forward towards Narrowband-Broadband Convergence, Proceedings of ISS'97 International Switching Symposium, Toronto, CA, September 21-26, 1997, pages 3 – 10", in which the signaling messages are transmitted for the first time with at least one first and one second individual bandwidth via a common signaling set or link set. The second individual bandwidth, as part of a broadband signaling system, is in this case considerably wider than the first individual bandwidth, which in principle represents a narrowband signaling system. As a result, a narrowband signaling system is for the first time proposed, via which both narrowband and broadband signaling can be carried out.

When using a conventional method and an associated apparatus for load distribution in the signaling network, this results in the signaling channel having the narrowest bandwidth (narrowband signaling) governing the maximum usable transmission rate per signaling set (link set). If, in consequence, the transmission rate for signaling messages to be transmitted is increased further, then this itself results in overloading on the signaling channel with the narrowest bandwidth when using conventional load distribution, while the signaling channels with the wider bandwidth (Broadband signaling) are scarcely loaded.

The present invention is, thus, directed toward providing an apparatus and a method for improving the load distribution in a signaling network, in which overloading of signaling channels is reliably prevented.

SUMMARY OF THE INVENTION

A respective individual bandwidth is preferably determined, and is subsequently evaluated, for each signaling channel available at a signaling node. Finally, the signaling messages to be distributed are distributed between the available signaling channels as a function of the respective evaluation result. Thus, even in the case of signaling networks which use signaling channels with different bandwidths, this results in optimum utilization of the respective signaling paths. Overloading of signaling channels or signaling sets is thus reliably prevented.

During the evaluation process, a relative bandwidth value is preferably determined for each available signaling channel with respect to the bandwidths of the available signaling channels, and the signaling messages to be transmitted are distributed in such a manner that a signaling channel having a wide individual bandwidth transmits at least the same number of signaling messages as a signaling channel having a narrow individual bandwidth. This allows widely differing calculation forms to be used for determining the relative bandwidth value, in which case correct or optimum assignment of signaling messages to those signaling channels which are not yet fully loaded can always be provided.

Furthermore, in the case of the method and the apparatus according to the present invention for improving the load distribution in a signaling network, each signaling channel can be assigned at least one signaling message to be transmitted, thus allowing improved maintenance at the signaling network via the network operator, at the expense of optimum load distribution. This, in consequence, considerably simplifies the capability to check the signaling channels which are, thus, at least partially loaded at all times.

Additional features and advantages of the present invention are described in, and will be apparent from, the following Detailed Description of the Invention and the Figures.

BRIEF DESCRIPTION OF THE FIGURES

Figure 1 shows a schematic view of two signaling nodes with signaling channels having different bandwidths.

Figure 2 shows a schematic view of a part of a signaling network having a large number of signaling sets.

DETAILED DESCRIPTION OF THE INVENTION

Figure 1 shows a schematic view of two signaling nodes A and B, which are connected to one another via a signaling set LS (link set). The signaling nodes A and B each represent, for example, a switching center, and have a message transfer part MTP1 and MTP2 (message transfer point) for transmitting signaling messages in the form of message signaling units (MSU). According to Figure 1, the signaling set LS includes a signaling channel L0 with an individual bandwidth EBB_0 of 64 kilobits per second. In the same way, the further signaling channels L1 and L2 also have an individual bandwidth of $EBB_1 = EBB_2 = 64$ kilobits per second. In contrast, a signaling channel L3 has a high transmission rate with an individual bandwidth EBB_3 of 2 Megabits per second. Such a signaling set LS occurs, for example, when a further signaling line with a high data rate (for example, a glass fiber cable) is added to an already existing signaling line.

On the basis of the signaling path selection field (SLS field) described initially in a message signaling unit (MSU), of the signaling message, the signaling channels L0 to L3 can be allocated or selected uniquely. In contrast to conventional selection methods, in which the signaling channels are selected only quantitatively, the apparatus and method according to the present invention allow a qualitative selection or allocation of signaling channels to be carried out for the signaling messages to be transmitted as a function of a respective individual bandwidth EBB_x of the various signaling channels.

The method and the apparatus for improving the load distribution in a signaling network and, in particular, the load distribution in the signaling set LS are described in detail in the following text.

First exemplary embodiment

In order to assign the signaling messages to be transmitted to the respective available signaling channels L0, L1, L2 and L3, the message transfer part MTP1 has what is referred to as a load distribution key (load sharing key), which essentially includes a table of signaling path selection field values (SLS values) and associated signaling channels (links). In the previous method, the distribution process was carried out in such a way that, as far as possible, an equal number of SLS values are allocated to each available signaling channel. If one considers this table and this load distribution key, then this results in a statement of the load distribution in the individual signaling channels and the higher-level signaling sets LS, which is based on a purely quantitative analysis of the signaling channels. However, a key feature for the present invention is the fact that qualitative allocation is carried out, furthermore, in addition to this quantitative allocation of SLS values and signaling channels. To be more precise, the message transfer part MTP1 has a determination device for determining a respective individual bandwidth EBB_x for the available signaling channels Lx, where x = 0 to 3. This determination device, which is not illustrated, in consequence records a respective individual bandwidth EBB_0, EBB_1 and EBB_2 of 64 kilobits per second for the signaling channels L0, L1 and L2. In contrast, this determination device records an individual bandwidth EBB_3 of 2 Megabits per second for the signaling channel L3. These determined individual bandwidths are stored in a database, and are linked to the load distribution key (load sharing key). To be more precise, a qualitative assessment is carried out of the individual signaling channels as a function of the respectively determined individual bandwidths EBB_0 to EBB_3. If these respective individual bandwidths are evaluated skillfully, the load distribution can be optimized for the individual signaling channels so as to reliably prevent overloading in individual signaling channels.

A number Z(x) of the signaling path selection values (SLS values) which are transmitted via a signaling channel x (where x = 0 to 3) are preferably determined as follows:

$$Z(x) = 16 \times EBB_x/GBB \qquad (1)$$

where $Z(x)$ represents the number of SLS values which are transmitted via the signaling channel x, EBB_x represents the individual bandwidth of the respective signaling channel x, and GBB represents the sum of the individual bandwidths for all the available signaling channels in the signaling set LS.

The multiplication of the quotient EBB_x/GBB in the equation (1) quoted above with the value 16 is based on the figure of 4 bits specified as a fixed value for the world market in the ITU standard for the SLS value in the CCS7 signaling network, as a result of which a maximum of 16 different SLS values can be represented. A different value range of the SLS values would accordingly result in a multiplier other than 16. If the individual bandwidths are evaluated in accordance with the equation described above, this results in the overall bandwidth GBB having a value of 3×64 kilobits + 2 Megabits per second = 35×64 kilobits per second. The values for the number of SLS values are thus:

$$Z(0) = 16 \times 1/35$$

$$Z(1) = 16 \times 1/35$$

$$Z(2) = 16 \times 1/35 \text{ and}$$

$$Z(3) = 16 \times 32/35$$

Since only rounded integers can be used for the number of SLS values, this would result in all 16 SLS values being distributed to the signaling channel L3. In consequence, the optimum load distribution in this first exemplary embodiment would lead to all the signaling messages being transmitted in the signaling channel L3.

However, in certain cases, this may be disadvantageous for the signaling network since, for example, redundant signaling lines are not used. Each signaling channel L0 to L3 is, thus, preferably assigned at least one signaling message to be transmitted, which furthermore makes it possible to improve the maintenance and capability to test the signaling paths. In addition, if one of the signaling channels (for example, L3) fails, it is possible to switch particularly easily and quickly to the signaling channels L0 to L2 which are still available.

Second exemplary embodiment

According to a second exemplary embodiment, which is not illustrated, the signaling set LS includes only two signaling channels with an individual bandwidth of 64 kilobits per second and 256 kilobits per second. This is the situation, for example, when there is already an E1 transmission path at 64 kilobits per second in the broadband CCS7 and, owing to an increase in the amount of traffic, the network operator now wishes to set up an additional STM1 optical transmission path from the signaling node A to the signaling node B which, for example, contains a signaling channel with a bandwidth of 256 kilobits per second. The existing CCS7 signaling channel at 64 kilobits per second is intended to be retained in this case, for redundance reasons. When using such a signaling set, the use of the equation described above results in the load distribution as described below for the number of SLS values.

$$Z(0) = 16 \times 64/320 = 3$$
$$\rightarrow \text{e.g. SLS} = 0, 1, 2$$

$$Z(1) = 16 \times 256/320 = 13$$
$$\rightarrow \text{e.g. SLS} = 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15.$$

As such, the signaling channel L0 transmits 3/16 of the load, and the signaling channel L1 transmits 13/16 of the load. In consequence, the signaling channel L1 is loaded by 1/16 more than the relative figure equivalent to its maximum bandwidth. In contrast to the conventional quantitative assignment of the signaling messages to be transmitted, $16/13 \times 256$ kilobits per second (315 kilobits per second) can be used with this method with the qualitative assignment process according to the present invention and with a total installed bandwidth GBB of 320 kilobits per second. This corresponds to an increase of 146 percent.

Third exemplary embodiment

In the first and second exemplary embodiments, the improvement in the load distribution was determined on the basis of an overall bandwidth GBB of subsequent ratio of formation in the ratio of the respective individual bandwidths.

However, the present invention is not restricted to this and also covers, for example, direct ratio of formation in the ratio of the respective individual bandwidths. In consequence, for example, a narrowest or widest individual bandwidth EBBmin/EBBmax can be determined in the message transfer path MTP1 with the quotient then being formed between this narrowest and widest individual bandwidth and the respective individual bandwidth to be considered.

If, as shown by way of example in Figure 1, the signaling channel L0 is used as the reference value for the narrowest individual bandwidth EBBmin (64 kilobits per second), then this results in the following quotients for the respective signaling channels:

L0 = 1

L1 = 1

L2 = 1

L3 = 32.

If, on the other hand, the widest individual bandwidth EBBmax of the signaling channel L3 (2 Megabits per second) is used as the reference value, this results in the following values for the quotients of the respective individual bandwidths:

L0 = 1/32

L1 = 1/32

L2 = 1/32

L3 = 1

In this case as well, the load distribution in a signaling network can be improved by evaluating the respective relative individual bandwidths (quotients).

According to a modification of this exemplary embodiment, as an alternative, the determined individual bandwidths of the available signaling channels L0 to L3 also can be multiplied, in which case a root can be formed in a subsequent step in order to produce the ratio between these individual bandwidths. The multiplication process is preferably carried out only for the individual

bandwidths of two signaling channels, since extraordinarily large numerical values would occur otherwise.

However, the present invention is not restricted to the evaluation methods described above and, in fact, covers all other evaluation methods in which the individual bandwidths of the signaling channels can be represented as their ratio to one another.

Fourth exemplary embodiment

Figure 2 shows a schematic view of a part of a signaling network according to a fourth exemplary embodiment, with a large number of signaling sets LS1, LS2 and LS3 being arranged between the signaling nodes A and B. A configuration such as this occurs, for example, when main traffic nodes in a signaling network need to be connected to one another, and it is necessary to process an extraordinarily high level of signaling traffic.

Since, as has already been described above, the signaling path selection fields (SLS fields) have only 4 bits, and thus can represent only 16 SLS values, one signaling set LS has a maximum of 16 signaling channels. Further signaling sets LS2 and LS3 are thus defined for unique association so that the capacity for transmitting signaling messages can be multiplied. This equally results in a considerably more complex representation for the mode of distribution key (load sharing key) which, in consequence, includes a large number of tables for the individual signaling sets LS1, LS2 and LS3, with the table for one signaling set LS associating the number of SLS values with the respective signaling channels available in that signaling set. In the same way as that described above, this table is associated with a database which includes the respective individual bandwidths of the available and active signaling channels. This also results in a qualitative association for the respective signaling channels for a signaling network having a number of signaling sets LS1, LS2 and LS3, thus ensuring optimum load distribution even when using signaling channels having different bandwidths, and reliably preventing the individual signaling channels or signaling sets from being overloaded.

The present invention has been described above with reference to a CCS7 signaling network. However, it is not restricted to this and can also be applied to other signaling networks in which signaling channels in each case have different bandwidths.

Indeed, although the present invention has been described with reference to specific embodiments, those of skill in the art will recognize that changes may be made thereto without departing from the spirit and scope of the invention as set forth in the hereafter appended claims.

ABSTRACT OF THE DISCLOSURE

An apparatus and method for improving the load distribution in a signaling network having a large number of signaling nodes and a large number of signaling channels, with overloading in the signaling network being reliably prevented by taking account of a respective individual bandwidth.

In the claims:

Cancelled claims 1-12 and added new claims 13-24.

CLAIMS

Please cancel claims 1-12, without prejudice, and substitute the following claims therefore:

13. A method for improving load distribution in a signaling network, the method compromising the steps of:

providing a plurality of signaling nodes for distributing signaling messages;

providing a plurality of signaling channels for transmitting the signaling messages, the signaling channels having at least one first and one second individual bandwidth, the second individual bandwidth being wider than the first individual bandwidth;

determining a respective available individual bandwidth for the signaling channels available at a signaling node;

evaluating the determined individual bandwidths; and

assigning the signaling messages to be transmitted to the available signaling channels as a function of a result of the step of evaluating.

14. A method for improving load distribution in a signaling network as claimed in Claim 13, wherein the step of evaluating includes determining, for the signaling channels, a relative bandwidth value with reference to the signaling channels available at a signaling node and wherein, as a result of the step of assigning, a signaling channel having a second individual bandwidth transmits at least a same number of signaling messages as a signaling channel having a first individual bandwidth.

15. A method for improving load distribution in a signaling network as claimed in Claim 13, wherein the step of evaluating includes determining a total sum of the bandwidths of the signaling channels available at a signaling node, and forming a quotient of the respective individual bandwidth and the determined total sum for the signaling channels.

16. A method for improving load distribution in a signaling network as claimed in Claim 13, wherein the step of evaluating includes determining a narrowest/widest individual bandwidth of the at least first and second individual bandwidths, and forming a quotient of the respective individual bandwidth and the determined narrowest/widest individual bandwidth for the signaling channels available at a signaling node.

17. A method for improving load distribution in a signaling network as claimed in Claim 13, wherein the step of evaluating includes determining a product of the respective available bandwidths and a predetermined individual bandwidth for the signaling channels available at a signaling node, and forming a root of the respectively determined products for the signaling channels available at a signaling node.

18. A method for improving load distribution in a signaling network as claimed in Claim 13, wherein at least one signaling message to be transmitted is assigned to the signaling channel available at a signaling node.

19. An apparatus for improving load distribution in a signaling network, comprising:

a plurality of signaling nodes for distributing signaling messages;

a plurality of signaling channels for transmitting the signaling messages, the signaling channels having at least one first and second individual bandwidth, with the second individual bandwidth being wider than the first individual bandwidth;

a determination device for determining a respectively available individual bandwidth for the signaling channels available at a signaling node;

an evaluation device for evaluating the determined bandwidths; and

an assignment device for assigning the signaling messages to be transmitted to the available signaling channels as a function of a result from the evaluation device.

20. An apparatus for improving load distribution in a signaling network as claimed in Claim 19, wherein in the evaluation device determines a relative bandwidth value for the signaling channels with respect to the signaling channels available at a signaling node, and the assignment device effects the assignment of the signaling messages such that a signaling channel having a second individual bandwidth transmits at least a same number of signaling messages as a signaling channeling having a first individual bandwidth.

21. An apparatus for improving load distribution in a signaling network as claimed in Claim 19, wherein the evaluation device determines a total sum of the individual bandwidths of the signaling channels available at a signaling node, and forms a quotient from the respective individual bandwidth and the determined total sum for each of the signaling channels.

22. An apparatus for improving a load distribution in a signaling network as claimed in Claim 19, wherein the evaluation device determines a narrowest/widest individual bandwidth of the at least one first and one second individual bandwidth and forms a quotient from the respective individual bandwidth of a signaling channel and the determined narrowest/widest individual bandwidth for each of the signaling channels available at a signaling node.

23. An apparatus for improving a load distribution in a signaling network as claimed in Claim 19, wherein the evaluation device determines a product of the available individual bandwidth with a predetermined individual bandwidth for each of the signaling channels available at a signaling node and forms a root of the respectively determined products for each of the signaling channels available at a signaling node.

24. An apparatus for improving a load distribution in a signaling network as claimed in Claim 19, wherein the assignment device assigns at least one signaling message to be transmitted to the signaling channels available at a signaling node.

REMARKS

The present amendment makes editorial changes and corrects typographical errors in the specification, which includes the Abstract, in order to conform the specification to the requirements of United States Patent Practice. No new matter is added thereby. Attached hereto is a marked-up version of the changes made to the specification by the present amendment. The attached page is captioned **"Version With Markings To Show Changes Made".**

In addition, the present amendment cancels original claims 1-12 in favor of new claims 13-24. Claims 13-24 have been presented solely because the revisions by red-lining and underlining which would have been necessary in claims 1-12 in order to present those claims in accordance with preferred United States Patent Practice would have been too extensive, and thus would have been too burdensome. The present amendment is intended for clarification purposes only and not for substantial reasons related to patentability pursuant to 35 U.S.C. §§103, 102, 103 or 112. Indeed, the cancellation of claims 1-12 does not constitute an intent on the part of the Applicants to surrender any of the subject matter of claims 1-12.

Early consideration on the merits is respectfully requested.

Respectfully submitted,

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VERSION WITH MARKINGS TO SHOW CHANGES MADE

In The Specification:

The Specification of the present application, including the Abstract, has been amended as follows:

~~Description~~ S P E C I F I C A T I O N

~~Apparatus~~ TITLE OF INVENTION

APPARATUS AND METHOD FOR ~~IMPROVING THE LOAD~~ IMPROVING LOAD DISTRIBUTION IN A SIGNALING ~~NETWORK~~ NETWORK

BACKGROUND OF THE INVENTION

The present invention relates to an apparatus and a method for improving the load distribution in a signaling network and, in particular, to what is referred to as a load sharing method~~,~~ which results in signaling data being distributed uniformly in a digital signaling network.

Communication nets or networks generally connect two subscriber terminals to one another via a number of line sections and switching devices in order to interchange messages (for example, voice, data, text and/or images). Control information and signaling messages can, in this case, be transmitted between the switching centers, for connection control and when using service features. Digital, computer-controlled communication networks, in particular, offer a considerably greater performance scope in comparison to analog communication networks, for which reason a new, powerful signaling system has been introduced in digital, computer-controlled communication networks.

The ITU (International Telecommunication Union) has thus specified the central signaling system No. 7 (CCS7), which is optimized for use in digital nets or networks.

In contrast to the previously normal channel-based signaling, the signaling messages in CCS7 are passed via separate signaling paths or signaling channels (links). A large number of such signaling channels (links) in this case form what is referred to as a signaling set (link set), ~~with a signaling set (link set) having~~ which

has a maximum of 16 signaling channels (links). A signaling channel transports the signaling messages for a number of user channels (trunks).

The signaling channels or signaling links (links or link sets) in CCS7 connect what are referred to as message transfer parts (MTP) in a communication network. The message transfer parts and the signaling channels thus form an autonomous signaling network~~,~~ which is superimposed on a user channel network.

The signaling end points are, in this case, the sources and sinks of the signaling traffic and are provided in a communication network primarily by switching centers or signaling nodes. In this case, the message transfer parts (MTP) transmit received signaling messages on the basis of a destination address (destination point code, DPC) to another message transfer part (MTP). No switching processing of the signaling messages is generally carried out in a message transfer part (MTP). A message transfer part may be integrated in a signaling end point (for example, a switching center), or may form an autonomous signaling node in the signaling network. One or more levels of message transfer parts (MTP) may be possible depending on the size of the signaling network.

All the signaling points in a predetermined signaling network are identified within a numbering plan, which is defined by the ITU~~, by means~~ via, for example, ~~of~~ a 14-point code (PC) and ~~can~~ thus can be addressed specifically in a signaling message. In CCS7, such a signaling message is provided by the message signaling unit MSU).

In addition to a destination address (destination point code DPC) and a source address (origin point code OPC), a speech circuit address (circuit identification code CIC) is ~~essentially~~ also stored in these signaling messages, which are transmitted in the signaling network, and message signaling units (MSU). This voice circuit address (CIC) has 12 bits according to the ITU Standard, with the 4 least-significant bits being referred to as a signaling path selection field (signaling link selection field, SLS). According to the ITU, the various voice signaling messages (MSU) are assigned predetermined signaling paths via this signaling path selection field (SLS values).

In a conventional signaling network, the signaling messages (MSU) to be transmitted are distributed uniformly between the available signaling channels (or active links in a signaling set of its link set) thus allowing the load to be distributed uniformly in the signaling network.

Such a conventional load distribution method is known from the reference "Wang J. L: A Novel Link Set Dimensioning Procedure for Networks supporting the Load Splitting Link Selection Algorithm, Proceedings to the Infocom '93 Annual Joint Conference of the computer and communications societies Conference Proceedings Vol. 12, March 28, 1993 – April 1, 1993, pages 1280 – 1287". This proposes a novel signaling set dimensioning method which is based on the "load splitting link selection" algorithm, in which randomly produced bit patterns are used for selecting a signaling channel. The capacity and available individual bandwidth in these signaling channels are, however, regarded as being essentially equivalent in this method. In order to improve the load distribution, particularly in cases where the increase in the total capacity in the signaling set (link set) is inadequate despite the addition of additional signaling channels, this document proposes a theorem for creating a special set of equivalent signaling channels~~, by means of~~ via which the actually available total capacity is used optimally, especially when using the "load splitting link selection" algorithm.

Particularly when using novel transmission techniques such as packet switching, ATM, IP etc., and a result of the use of novel transmission media, such as glass fiber cables, signaling configurations have increasingly arisen in which signaling channels occur with different bandwidths~~,~~; that is ~~to say~~, transmission rates for the signaling messages (MSU).

Such a method and an apparatus for providing load distribution in a signaling network having a large number of signaling nodes for distribution of signaling messages, and a large number of signaling channels for transmitting signaling messages, are known from the reference "Franz R. et al.: ATM-Based SS7 for Narrowband Networks – A step forward towards Narrowband-Broadband Convergence, Proceedings of ISS'97 International Switching Symposium, Toronto, CA, September 21-26, 1997, pages 3 – 10", in which the signaling messages are

transmitted for the first time with at least one first and one second individual bandwidth via a common signaling set or link set. The second individual bandwidth, as part of a broadband signaling system, is in this case considerably wider than the first individual bandwidth, which in principle represents a narrowband signaling system. ~~In consequence~~ As a result, a narrowband signaling system is for the first time proposed, ~~by means of~~ via which both narrowband and broadband signaling can be carried out.

When using a conventional method and an associated apparatus for load distribution in the signaling network, this ~~means that~~ results in the signaling channel having the narrowest bandwidth (narrowband signaling) ~~governs~~ governing the maximum usable transmission rate per signaling set (link set). If, in consequence, the transmission rate for signaling messages to be transmitted is increased further, then this itself results in overloading on the signaling channel with the narrowest bandwidth when using conventional load distribution, while the signaling channels with the wider bandwidth (Broadband signaling) are scarcely loaded.

The present invention is ~~thus based on the object of~~, thus, directed toward providing an apparatus and a method for improving the load distribution in a signaling network, in which overloading of signaling channels is reliably prevented.

~~According to the invention, this object is achieved with regard to the method by the measures in patent claim 1, and with regard to the apparatus by the features in patent claim 7.~~ SUMMARY OF THE INVENTION

A respective individual bandwidth is preferably determined, and is subsequently evaluated, for each signaling channel available at a signaling node. Finally, the signaling messages to be distributed are distributed between the available signaling channels as a function of the respective evaluation result. Thus, even in the case of signaling networks which use signaling channels with different bandwidths, this results in optimum utilization of the respective signaling paths. Overloading of signaling channels or signaling sets is thus reliably prevented.

During the evaluation process, a relative bandwidth value is preferably determined for each available signaling channel with respect to the bandwidths of the available signaling channels, and the signaling messages to be transmitted are distributed in such a manner that a signaling channel having a wide individual bandwidth transmits at least the same number of signaling messages as a signaling channel having a narrow individual bandwidth. This allows widely differing calculation forms to be used for determining the relative bandwidth value, in which case correct or optimum assignment of signaling messages to those signaling channels which are not yet fully loaded can always be provided.

Furthermore, in the case of the method and the apparatus according to the present invention for improving the load distribution in a signaling network, each signaling channel can be assigned at least one signaling message to be transmitted, thus allowing improved maintenance at the signaling network ~~by means of~~ via the network operator, at the expense of optimum load distribution. This, in consequence, considerably simplifies the capability to check the signaling channels~~,~~ which are, thus, at least partially loaded at all times.

~~Advantageous refinements of the invention are characterized in the further dependent claims.~~ Additional features and advantages of the present invention are described in, and will be apparent from, the following Detailed Description of the Invention and the Figures.

~~The invention will be described in more detail in the following text using the exemplary embodiments and with reference to the drawings, in which:~~

BRIEF DESCRIPTION OF THE FIGURES

Figure 1 shows a schematic view of two signaling nodes with signaling channels having different bandwidths~~; and~~.

Figure 2 shows a schematic view of a part of a signaling network having a large number of signaling sets.

DETAILED DESCRIPTION OF THE INVENTION

Figure 1 shows a schematic view of two signaling nodes A and B, which are connected to one another via a signaling set LS (link set). The signaling nodes A and B each represent, for example, a switching center, and have a message transfer

part MTP1 and MTP2 (message transfer point) for transmitting signaling messages in the form of message signaling units (MSU). According to Figure 1, the signaling set LS ~~comprises~~ includes a signaling channel L0 with an individual bandwidth EBB_0 of 64 kilobits per second. In the same way, the further signaling channels L1 and L2 also have an individual bandwidth of $EBB_1 = EBB_2 = 64$ kilobits per second. In contrast, a signaling channel L3 has a high transmission rate with an individual bandwidth EBB_3 of 2 Megabits per second. Such a signaling set LS occurs, for example, when a further signaling line with a high data rate (for example, a glass fiber cable) is added to an already existing signaling line.

On the basis of the signaling path selection field (SLS field) described initially in a message signaling unit (MSU), of the signaling message, the signaling channels L0 to L3 can be allocated or selected uniquely. In contrast to conventional selection methods, in which the signaling channels are selected only quantitatively, the apparatus and method according to the ~~invention and the method according to the invention mean that~~ present invention allow a qualitative selection or allocation of signaling channels ~~is~~ to be carried out for the signaling messages to be transmitted as a function of a respective individual bandwidth EBB_x of the various signaling channels.

The method and the apparatus for improving the load distribution in a signaling network and, in particular, the load distribution in the signaling set LS are described in detail in the following text.

First exemplary embodiment

In order to assign the signaling messages to be transmitted to the respective available signaling channels L0, L1, L2 and L3, the message transfer part MTP1 has what is referred to as a load distribution key (load sharing key), which essentially ~~comprises~~ includes a table of signaling path selection field values (SLS values) and associated signaling channels (links). In the previous method, the distribution process was carried out in such a way that, as far as possible, an equal number of SLS values are allocated to each available signaling channel. If one considers this table and this load distribution key, then this results in a statement of the load distribution in the individual signaling channels and the higher-level

signaling sets LS, which is based on a purely quantitative analysis of the signaling channels. However, ~~the essential~~ a key feature for the present invention is the fact that qualitative allocation is carried out, furthermore, in addition to this quantitative allocation of SLS values and signaling channels. To be more precise, the message transfer part MTP1 ~~furthermore~~ has a determination device for determining a respective individual bandwidth EBB_x for the available signaling channels Lx, where x = 0 to 3. This determination device, which is not illustrated, in consequence records a respective individual bandwidth EBB_0, EBB_1 and EBB_2 of 64 kilobits per second for the signaling channels L0, L1 and L2. In contrast, this determination device records an individual bandwidth EBB_3 of 2 Megabits per second for the signaling channel L3. These determined individual bandwidths are stored in a database, and are linked to the load distribution key (load sharing key). To be more precise, a qualitative assessment is carried out of the individual signaling channels as a function of the respectively determined individual bandwidths EBB_0 to EBB_3. If these respective individual bandwidths are evaluated skillfully, the load distribution can be optimized for the individual signaling channels so as to reliably prevent overloading in individual signaling channels.

A number Z(x) of the signaling path selection values (SLS values) which are transmitted via a signaling channel x (where x = 0 to 3) are preferably determined as follows:

$$Z(x) = 16 \times EBB_x/GBB \qquad (1)$$

where Z(x) represents the number of SLS values which are transmitted via the signaling channel x, EBB_x represents the individual bandwidth of the respective signaling channel x, and GBB represents the sum of the individual bandwidths for all the available signaling channels in the signaling set LS.

The multiplication of the quotient EBB_x/GBB in the equation (1) quoted above with the value 16 is based on the figure of 4 bits specified as a fixed value for the world market in the ITU standard for the SLS value in the CCS7 signaling network, as a result of which a maximum of 16 different SLS values can be represented. A different value range of the SLS values would accordingly result in

a multiplier other than 16. If the individual bandwidths are evaluated in accordance with the equation described above, this ~~thus~~ results in the overall bandwidth GBB having a value of 3×64 kilobits + 2 Megabits per second = 35×64 kilobits per second. The values for the number of SLS values are thus:

$$Z(0) = 16 \times 1/35$$

$$Z(1) = 16 \times 1/35$$

$$Z(2) = 16 \times 1/35 \text{ and}$$

$$Z(3) = 16 \times 32/35$$

Since only rounded integers can be used for the number of SLS values, this would result in all 16 SLS values being distributed to the signaling channel L3. In consequence, the optimum load distribution in this first exemplary embodiment would lead to all the signaling messages being transmitted in the signaling channel L3.

However, in certain cases, this may be disadvantageous for the signaling network since, for example, redundant signaling lines are not used. Each signaling channel L0 to L3 is, thus, preferably assigned at least one signaling message to be transmitted, which furthermore makes it possible to improve the maintenance and capability to test the signaling paths. In addition, if one of the signaling channels (for example, L3) fails, it is possible to switch particularly easily and quickly to the signaling channels L0 to L2 which are still available.

Second exemplary embodiment

According to a second exemplary embodiment, which is not illustrated, the signaling set LS ~~comprises~~ includes only two signaling channels with an individual bandwidth of 64 kilobits per second and 256 kilobits per second. This is the situation, for example, when there is already an E1 transmission path at 64 kilobits per second in the broadband CCS7 and, owing to an increase in the amount of traffic, the network operator now wishes to set up an additional STM1 optical transmission path from the signaling node A to the signaling node B~~;~~ which, for example, contains a signaling channel with a bandwidth of 256 kilobits per second. The existing CCS7 signaling channel at 64 kilobits per second is intended to be

retained in this case, for redundance reasons. When using such a signaling set, the use of the equation described above results in the load distribution as described below for the number of SLS values.

$$Z(0) = 16 \times 64/320 = 3$$

$\rightarrow$ e.g. SLS = 0, 1, 2

$$Z(1) = 16 \times 256/320 = 13$$

$\rightarrow$ e.g. SLS = 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15.

As such, ~~This means that~~ the signaling channel L0 transmits 3/16 of the load, and the signaling channel L1 transmits 13/16 of the load. In consequence, the signaling channel L1 is loaded by 1/16 more than the relative figure equivalent to its maximum bandwidth. In contrast to the conventional quantitative assignment of the signaling messages to be transmitted, 16/13 × 256 kilobits per second~~, that is to say~~ (315 kilobits per second~~,~~) can be used with this method with the qualitative assignment process according to the present invention and with a total installed bandwidth GBB of 320 kilobits per second~~, and this~~. This corresponds to an increase of 146 percent.

Third exemplary embodiment

In the first and second exemplary embodiments, the improvement in the load distribution was determined on the basis of an overall bandwidth GBB of subsequent ratio of formation in the ratio of the respective individual bandwidths. However, the present invention is not restricted to this and also covers, for example, direct ratio of formation in the ratio of the respective individual bandwidths. In consequence, for example, a narrowest or widest individual bandwidth EBBmin/EBBmax can be determined in the message transfer path MTP1 with the quotient then being formed between this narrowest and widest individual bandwidth and the respective individual bandwidth to be considered.

If, as shown by way of example in Figure 1, the signaling channel L0 is used as the reference value for the narrowest individual bandwidth EBBmin (64

kilobits per second), then this results in the following quotients for the respective signaling channels:

L0 = 1

L1 = 1

L2 = 1

L3 = 32.

If, on the other hand, the widest individual bandwidth EBBmax of the signaling channel L3 (2 Megabits per second) is used as the reference value, this results in the following values for the quotients of the respective individual bandwidths:

L0 = 1/32

L1 = 1/32

L2 = 1/32

L3 = 1

In this case as well, the load distribution in a signaling network can be improved by evaluating the respective relative individual bandwidths (quotients).

According to a modification of this exemplary embodiment, as an alternative, the determined individual bandwidths of the available signaling channels L0 to L3 ~~can~~ also can be multiplied, in which case a root can be formed in a subsequent step in order to produce the ratio between these individual bandwidths. The multiplication process is preferably carried out only for the individual bandwidths of two signaling channels, since extraordinarily large numerical values would occur otherwise.

However, the present invention is not restricted to the evaluation methods described above and, in fact, covers all other evaluation methods in which the individual bandwidths of the signaling channels can be represented as their ratio to one another.

Fourth exemplary embodiment

Figure 2 shows a schematic view of a part of a signaling network according to a fourth exemplary embodiment, with a large number of signaling sets LS1, LS2 and LS3 being arranged between the signaling nodes A and B. A configuration such as this occurs, for example, when main traffic nodes in a signaling network need to be connected to one another, and it is necessary to process an extraordinarily high level of signaling traffic.

Since, as has already been described above, the signaling path selection fields (SLS fields) have only 4 bits, and ~~in consequence~~ thus can represent only 16 SLS values, one signaling set LS has a maximum of 16 signaling channels. Further signaling sets LS2 and LS3 are thus defined for unique association~~,~~ so that the capacity for transmitting signaling messages can be multiplied. This equally results in a considerably more complex representation for the mode of distribution key (load sharing key) which, in consequence, ~~comprises~~ includes a large number of tables for the individual signaling sets LS1, LS2 and LS3, with the table for one signaling set LS associating the number of SLS values with the respective signaling channels available in that signaling set. In the same way as that described above, this table is associated with a database which includes the respective individual bandwidths of the available and active signaling channels. This also results in a qualitative association for the respective signaling channels for a signaling network having a number of signaling sets LS1, LS2 and LS3, thus ensuring optimum load distribution even when using signaling channels having different bandwidths, and reliably preventing the individual signaling channels or signaling sets from being overloaded.

The present invention has been described above with reference to a CCS7 signaling network. However, it is not restricted to this and can also be applied to other signaling networks in which signaling channels in each case have different bandwidths.

~~Abstract~~ Indeed, although the present invention has been described with reference to specific embodiments, those of skill in the art will recognize that changes may be made thereto without departing from the spirit and scope of the invention as set forth in the hereafter appended claims.

~~Apparatus~~ ABSTRACT OF THE DISCLOSURE

An apparatus and method for improving the load distribution in a signaling network

~~The invention relates to an apparatus and a method for improving the load distribution in a signaling network~~ having a large number of signaling nodes ~~(A, B)~~ and a large number of signaling channels~~(L0, L1, L2, L3)~~, with overloading in the signaling network being reliably prevented by taking account of a respective individual bandwidth~~(EBB0 to EBB3).~~.

~~Figure 1~~

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Description

Apparatus and method for improving the load distribution in a signaling network

The present invention relates to an apparatus and a method for improving the load distribution in a signaling network and, in particular, to what is referred to as a load sharing method, which results in signaling data being distributed uniformly in a digital signaling network.

Communication nets or networks generally connect two subscriber terminals to one another via a number of line sections and switching devices in order to interchange messages (for example voice, data, text and/or images). Control information and signaling messages can in this case be transmitted between the switching centers, for connection control and when using service features. Digital, computer-controlled communication networks, in particular, offer a considerably greater performance scope in comparison to analog communication networks, for which reason a new, powerful signaling system has been introduced in digital, computer-controlled communication networks.

The ITU (International Telecommunication Union) has thus specified the central signaling system No. 7 (CCS7), which is optimized for use in digital nets or networks.

In contrast to the previously normal channel-based signaling, the signaling messages in CCS7 are passed via separate signaling paths or signaling channels (links). A large number of such signaling channels (links) in this case form what is referred to as a

signaling set (link set), with a

signaling set (link set) having a maximum of 16 signaling channels (links). A signaling channel transports the signaling messages for a number of user channels (trunks).

The signaling channels or signaling links (links or link sets) in CCS7 connect what are referred to as message transfer parts (MTP) in a communication network. The message transfer parts and the signaling channels thus form an autonomous signaling network, which is superimposed on a user channel network.

The signaling end points are in this case the sources and sinks of the signaling traffic and are provided in a communication network primarily by switching centers or signaling nodes. In this case, the message transfer parts (MTP) transmit received signaling messages on the basis of a destination address (destination point code, DPC) to another message transfer part (MTP). No switching processing of the signaling messages is generally carried out in a message transfer part (MTP). A message transfer part may be integrated in a signaling end point (for example a switching center), or may form an autonomous signaling node in the signaling network. One or more levels of message transfer parts (MTP) may be possible depending on the size of the signaling network.

All the signaling points in a predetermined signaling network are identified within a numbering plan, which is defined by the ITU, by means, for example, of a 14-point code (PC) and can thus be addressed specifically in a signaling message. In CCS7, such a signaling message is provided by the message signaling unit MSU).

In addition to a destination address (destination point code DPC) and a source address (origin point code OPC), a speech circuit address (circuit identification code CIC) is essentially also stored in these signaling messages, which are transmitted in the signaling network, and message signaling units (MSU). This voice circuit address (CIC) has 12 bits according to the ITU Standard, with the 4 least-significant bits being referred to as a signaling path selection field (signaling link selection field, SLS). According to the ITU, the various voice signaling messages (MSU) are assigned predetermined signaling paths via this signaling path selection field (SLS values).

In a conventional signaling network, the signaling messages (MSU) to be transmitted are distributed uniformly between the available signaling channels or active links in a signaling set of its link set) thus allowing the load to be distributed uniformly in the signaling network.

Such a conventional load distribution method is known from the reference "Wang J. L: A Novel Link Set Dimensioning Procedure for Networks supporting the Load Splitting Link Selection Algorithm, Proceedings to the Infocom '93 Annual Joint Conference of the computer and communications societies Conference Proceedings Vol. 12, March 28, 1993 - April 1, 1993, pages 1280 - 1287". This proposes a novel signaling set dimensioning method which is based on the "load splitting link selection" algorithm, in which randomly produced bit patterns are used for selecting a signaling channel. The capacity and available individual bandwidth in these signaling channels are, however, regarded as being essentially equivalent in this method. In order to improve the load distribution, particularly in cases where the increase

in the total capacity in the signaling set (link set) is inadequate despite the addition of additional signaling channels, this document proposes a theorem for creating a special set of equivalent signaling channels, by means of which the actually available total capacity is used optimally, especially when using the "load splitting link selection" algorithm.

Particularly when using novel transmission techniques such as packet switching, ATM, IP etc., and a result of the use of novel transmission media, such as glass fiber cables, signaling configurations have increasingly arisen in which signaling channels occur with different bandwidths, that is to say transmission rates for the signaling messages (MSU).

Such a method and an apparatus for providing load distribution in a signaling network having a large number of signaling nodes for distribution of signaling messages, and a large number of signaling channels for transmitting signaling messages, are known from the reference "Franz R. et al.: ATM-Based SS7 for Narrowband Networks - A step forward towards Narrowband-Broadband Convergence, Proceedings of ISS'97 International Switching Symposium, Toronto, CA, September 21-26, 1997, pages 3 - 10", in which the signaling messages are transmitted for the first time with at least one first and one second individual bandwidth via a common signaling set or link set. The second individual bandwidth, as part of a broadband signaling system, is in this case considerably wider than the first individual bandwidth, which in principle represents a narrowband signaling system. In

consequence, a narrowband signaling system is for the first time proposed, by means of which both narrowband and broadband signaling can be carried out.

When using a conventional method and an associated apparatus for load distribution in the signaling network, this means that the signaling channel having the narrowest bandwidth (narrowband signaling) governs the maximum usable transmission rate per signaling set (link set). If, in consequence, the transmission rate for signaling messages to be transmitted is increased further, then this itself results in overloading on the signaling channel with the narrowest bandwidth when using conventional load distribution, while the signaling channels with the wider bandwidth (Broadband signaling) are scarcely loaded.

The invention is thus based on the object of providing an apparatus and a method for improving the load distribution in a signaling network, in which overloading of signaling channels is reliably prevented.

According to the invention, this object is achieved with regard to the method by the measures in patent claim 1, and with regard to the apparatus by the features in patent claim 7.

A respective individual bandwidth is preferably determined, and is subsequently evaluated, for each signaling channel available at a signaling node. Finally, the signaling messages to be distributed are distributed between the available signaling channels as a function of the respective evaluation result. Thus, even in the case of signaling networks which use signaling channels with different bandwidths, this results in optimum utilization of the respective signaling paths. Overloading of signaling channels or signaling sets is thus reliably prevented.

During the evaluation process, a relative bandwidth value is preferably determined for each available signaling channel with respect to the bandwidths of the available signaling channels, and the signaling messages to be transmitted are distributed in such a manner that a signaling channel having a wide individual bandwidth transmits at least the same number of signaling messages as a signaling channel having a narrow individual bandwidth. This allows widely differing calculation forms to be used for determining the relative bandwidth value, in which case correct or optimum assignment of signaling messages to those signaling channels which are not yet fully loaded can always be provided.

Furthermore, in the case of the method and the apparatus according to the invention for improving the load distribution in a signaling network, each signaling channel can be assigned at least one signaling message to be transmitted, thus allowing improved maintenance at the signaling network by means of the network operator, at the expense of optimum load distribution. This in consequence considerably simplifies the capability to check the signaling channels, which are thus at least partially loaded at all times.

Advantageous refinements of the invention are characterized in the further dependent claims.

The invention will be described in more detail in the following text using the exemplary embodiments and with reference to the drawings, in which:

Figure 1 shows a schematic view of two signaling nodes with signaling channels having different bandwidths; and

Figure 2 shows a schematic view of a part of a signaling network having a large number of signaling sets.

Figure 1 shows a schematic view of two signaling nodes A and B, which are connected to one another via a signaling set LS (link set). The signaling nodes A and B each represent, for example, a switching center, and have a message transfer part MTP1 and MTP2 (message transfer point) for transmitting signaling messages in the form of message signaling units (MSU). According to Figure 1, the signaling set LS comprises a signaling channel L0 with an individual bandwidth EBB_0 of 64 kilobits

per second. In the same way, the further signaling channels L1 and L2 also have an individual bandwidth of $EBB_1 = EBB_2 = 64$ kilobits per second. In contrast, a signaling channel L3 has a high transmission rate with an individual bandwidth EBB_3 of 2 Megabits per second. Such a signaling set LS occurs, for example, when a further signaling line with a high data rate (for example a glass fiber cable) is added to an already existing signaling line.

On the basis of the signaling path selection field (SLS field) described initially in a message signaling unit (MSU), of the signaling message, the signaling channels L0 to L3 can be allocated or selected uniquely. In contrast to conventional selection methods, in which the signaling channels are selected only quantitatively, the apparatus according to the invention and the method according to the invention mean that a qualitative selection or allocation of signaling channels is carried out for the signaling messages to be transmitted as a function of a respective individual bandwidth EBB_x of the various signaling channels.

The method and the apparatus for improving the load distribution in a signaling network and, in particular, the load distribution in the signaling set LS are described in detail in the following text.

First exemplary embodiment

In order to assign the signaling messages to be transmitted to the respective available signaling channels L0, L1, L2 and L3, the message transfer part MTP1 has what is referred to as a load distribution key (load sharing key), which essentially comprises a table of signaling path selection field values (SLS values)

and associated signaling channels (links). In the previous method,

the distribution process was carried out in such a way that as far as possible an equal number of SLS values are allocated to each available signaling channel. If one considers this table and this load distribution key, then this results in a statement of the load distribution in the individual signaling channels and the higher-level signaling sets LS, which is based on a purely quantitative analysis of the signaling channels. However, the essential feature for the present invention is the fact that qualitative allocation is carried out, furthermore, in addition to this quantitative allocation of SLS values and signaling channels. To be more precise, the message transfer part MTP1 furthermore has a determination device for determining a respective individual bandwidth EBB_x for the available signaling channels Lx, where x = 0 to 3. This determination device, which is not illustrated, in consequence records a respective individual bandwidth EBB_0, EBB_1 and EBB_2 of 64 kilobits per second for the signaling channels L0, L1 and L2. In contrast, this determination device records an individual bandwidth EBB_3 of 2 Megabits per second for the signaling channel L3. These determined individual bandwidths are stored in a database, and are linked to the load distribution key (load sharing key). To be more precise, a qualitative assessment is carried out of the individual signaling channels as a function of the respectively determined individual bandwidths EBB_0 to EBB_3. If these respective individual bandwidths are evaluated skillfully, the load distribution can be optimized for the individual signaling channels so as to reliably prevent overloading in individual signaling channels.

A number Z(x) of the signaling path selection values (SLS values) which are transmitted via a signaling channel x (where x = 0 to 3) are preferably determined as follows:

$$Z(x) = 16 \times EBB_x/GBB \qquad (1)$$

where Z(x) represents the number of SLS values which are transmitted via the signaling channel x, EBB_x represents the individual bandwidth of the respective signaling channel x, and GBB represents the sum of the individual bandwidths for all the available signaling channels in the signaling set LS.

The multiplication of the quotient EBB_x/GBB in the equation (1) quoted above with the value 16 is based on the figure of 4 bits specified as a fixed value for the world market in the ITU standard for the SLS value in the CCS7 signaling network, as a result of which a maximum of 16 different SLS values can be represented. A different value range of the SLS values would accordingly result in a multiplier other than 16. If the individual bandwidths are evaluated in accordance with the equation described above, this thus results in the overall bandwidth GBB having a value of 3 × 64 kilobits + 2 Megabits per second = 35 × 64 kilobits per second. The values for the number of SLS values are thus:

$Z(0) = 16 \times 1/35$
$Z(1) = 16 \times 1/35$
$Z(2) = 16 \times 1/35$ and
$Z(3) = 16 \times 32/35$

Since only rounded integers can be used for the number of SLS values, this would result in all 16 SLS values being distributed to the signaling channel L3. In consequence, the optimum load distribution in this first exemplary embodiment would lead to all the signaling messages being transmitted in the signaling channel L3.

However, in certain cases, this may be disadvantageous for the signaling network since, for example, redundant

signaling lines are not used. Each signaling channel L0 to L3 is thus preferably assigned at least

one signaling message to be transmitted, which furthermore makes it possible to improve the maintenance and capability to test the signaling paths. In addition, if one of the signaling channels (for example L3) fails, it is possible to switch particularly easily and quickly to the signaling channels L0 to L2 which are still available.

Second exemplary embodiment

According to a second exemplary embodiment, which is not illustrated, the signaling set LS comprises only two signaling channels with an individual bandwidth of 64 kilobits per second and 256 kilobits per second. This is the situation, for example, when there is already an E1 transmission path at 64 kilobits per second in the broadband CCS7 and, owing to an increase in the amount of traffic, the network operator now wishes to set up an additional STM1 optical transmission path from the signaling node A to the signaling node B, which, for example, contains a signaling channel with a bandwidth of 256 kilobits per second. The existing CCS7 signaling channel at 64 kilobits per second is intended to be retained in this case, for redundance reasons. When using such a signaling set, the use of the equation described above results in the load distribution as described below for the number of SLS values.

$Z(0) = 16 \times 64/320 = 3$
$\rightarrow$ e.g. SLS = 0, 1, 2

$Z(1) = 16 \times 256/320 = 13$
$\rightarrow$ e.g. SLS = 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15.

This means that the signaling channel L0 transmits 3/16 of the load, and the signaling channel L1 transmits

13/16 of the load. In consequence, the signaling channel L1 is loaded by 1/16 more than the relative figure equivalent to its maximum bandwidth. In contrast to the

conventional quantitative assignment of the signaling messages to be transmitted, 16/13 × 256 kilobits per second, that is to say 315 kilobits per second, can be used with this method with the qualitative assignment process according to the invention and with a total installed bandwidth GBB of 320 kilobits per second, and this corresponds to an increase of 146 percent.

Third exemplary embodiment

In the first and second exemplary embodiments, the improvement in the load distribution was determined on the basis of an overall bandwidth GBB of subsequent ratio of formation in the ratio of the respective individual bandwidths. However, the invention is not restricted to this and also covers, for example, direct ratio of formation in the ratio of the respective individual bandwidths. In consequence, for example, a narrowest or widest individual bandwidth EBBmin/EBBmax can be determined in the message transfer path MTP1 with the quotient then being formed between this narrowest and widest individual bandwidth and the respective individual bandwidth to be considered.

If, as shown by way of example in Figure 1, the signaling channel L0 is used as the reference value for the narrowest individual bandwidth EBBmin (64 kilobits per second), then this results in the following quotients for the respective signaling channels:

L0 = 1
L1 = 1
L2 = 1
L3 = 32.

If, on the other hand, the widest individual bandwidth EBBmax of the signaling channel L3 (2 Megabits per second) is used as the reference value, this results in

the following values for the quotients of the respective individual bandwidths:

L0 = 1/32

L1 = 1/32

L2 = 1/32

L3 = 1

In this case as well, the load distribution in a signaling network can be improved by evaluating the respective relative individual bandwidths (quotients).

According to a modification of this exemplary embodiment, as an alternative, the determined individual bandwidths of the available signaling channels L0 to L3 can also be multiplied, in which case a root can be formed in a subsequent step in order to produce the ratio between these individual bandwidths. The multiplication process is preferably carried out only for the individual bandwidths of two signaling channels, since extraordinarily large numerical values would occur otherwise.

However, the invention is not restricted to the evaluation methods described above and, in fact, covers all other evaluation methods in which the individual bandwidths of the signaling channels can be represented as their ratio to one another.

Fourth exemplary embodiment

Figure 2 shows a schematic view of a part of a signaling network according to a fourth exemplary embodiment, with a large number of signaling sets LS1, LS2 and LS3 being arranged between the signaling nodes A and B. A configuration such as this occurs, for example, when main traffic nodes in a signaling network need to be connected to one another, and it is necessary

to process an extraordinarily high level of signaling traffic.

Since, as has already been described above, the signaling path selection fields (SLS fields) have only 4 bits, and in consequence can represent only 16 SLS values, one signaling set LS has a maximum of 16 signaling channels. Further signaling sets LS2 and LS3 are thus defined for unique association, so that the capacity for transmitting signaling messages can be multiplied. This equally results in a considerably more complex representation for the mode of distribution key (load sharing key) which, in consequence, comprises a large number of tables for the individual signaling sets LS1, LS2 and LS3, with the table for one signaling set LS associating the number of SLS values with the respective signaling channels available in that signaling set. In the same way as that described above, this table is associated with a database which includes the respective individual bandwidths of the available and active signaling channels. This also results in a qualitative association for the respective signaling channels for a signaling network having a number of signaling sets LS1, LS2 and LS3, thus ensuring optimum load distribution even when using signaling channels having different bandwidths, and reliably preventing the individual signaling channels or signaling sets from being overloaded.

The invention has been described above with reference to a CCS7 signaling network. However, it is not restricted to this and can also be applied to other signaling networks in which signaling channels in each case have different bandwidths.

Patent Claims

1. A method for improving the load distribution in a signaling network having
a large number of signaling nodes (A, B) for distributing signaling messages, and
a large number of signaling channels (L0, L1, L2, L3) for transmitting signaling messages, having at least one first and one second individual bandwidth (EBB_0 to EBB_3), with the second individual bandwidth (EBB_3) being wider than the first individual bandwidth (EBB_0 to EBB_2).
characterized by the following steps:
a) determining a respective available individual bandwidth (EBB_0 to EBB_3) for the signaling channels (L0 to L3) available at a signaling node (A);
b) evaluating the determined individual bandwidths (EBB_0 to EBB_3); and
c) assigning the signaling messages to be transmitted to the available signaling channels as a function of the result of the evaluation in step b).

2. The method as claimed in patent claim 1, characterized in that, during the evaluation process,
in step b), for the signaling channels (L0 to L3) a relative bandwidth value is in each case determined with reference to the signaling channels available at a signaling node; and
in step c), the assignment of the signaling messages to be transmitted is carried out in such a manner that a signaling channel (L3) having a second individual bandwidth (EBB_3) transmits at least the same number of signaling messages as a signaling channel (L0) having a first individual bandwidth (EBB_0).

3. The method as claimed in patent claim 1 or 2, characterized
in that, in step b),
b1) a total sum of the individual bandwidths (EBB_0 to EBB_3) of the signaling channels (L0 to L3) available at a signaling node is determined; and
b2) a quotient of the respective individual bandwidth (EEB_0 to EBB_3) and of the determined total sum is in each case formed for the signaling channels (L0 to L3).

4. The method as claimed in patent claim 1 or 2, characterized
in that, in step b),
b1) a narrowest/widest individual bandwidth (EBB_0/EBB_3) of the at least first and second individual bandwidths (EBB_0 to EBB_3) is determined, and
b2) a quotient of the respective individual bandwidth (EBB_0 to EBB_3) and of the determined narrowest/widest individual bandwidth (EBB_0/EBB_3) is in each case formed for the signaling channels available at a signaling node.

5. The method as claimed in patent claim 1 or 2, characterized
in that, in step b),
b1) a product of the respective available individual bandwidths (EBB_0 to EBB_3) and a predetermined individual bandwidth is in each case determined for the signaling channels (L0 to L3) available at a signaling node, and
b2) a root of the respectively determined products is in each case formed for the signaling channels (L0 to L3) available at a signaling node.

6. The method as claimed in patent claims 1 to 5,

characterized in that at least one signaling message which is to be transmitted is in each case assigned to the signaling channel

available at a signaling node.

7. An apparatus for improving the load distribution in a signaling network having
a large number of signaling nodes (A, B) for distributing signaling messages, and
a large number of signaling channels (L0 to L3) for transmitting signaling messages, having at least one first and one second individual bandwidth (EBB_0 to EBB_3), with the second individual bandwidth (EBB_3) being wider than the first individual bandwidth (EBB_0 to EBB_2),
characterized by
a determination device for determining a respectively available individual bandwidth (EBB_0 to EBB_3) for the signaling channels (L0 to L3) available at a signaling node (A, B);
an evaluation device for evaluating the determined individual bandwidths (EBB_0 to EBB_3); and
an assignment device for assigning the signaling messages to be transmitted to the available signaling channels (L0 to L3) as a function of the result from the evaluation device.

8. The apparatus as claimed in patent claim 7, characterized in that the evaluation device in each case determines a relative bandwidth value for the signaling channels (L0 to L3) with respect to the signaling channels available at a signaling node, and
the assignment device carries out the assignment of the signaling messages to be transmitted in such a manner that a signaling channel having a second individual bandwidth (EBB_3) transmits at least the same number of signaling messages as a signaling channel (EBB_0) having a first individual bandwidth.

9. The apparatus as claimed in patent claim 1 or 2,
characterized in that the evaluation device in each case determines a total sum of the individual bandwidths of the signaling channels (L0 to L3) available at a signaling node, and forms a quotient from the respective individual bandwidth and the determined total sum for each of the signaling channels (L0 to L3).

10. The apparatus as claimed in patent claim 7 or 8,
characterized in that the evaluation device determines a narrowest/widest individual bandwidth (EBB_3/EBB_0), of the at least one first and one second individual bandwidth and forms a quotient from the respective individual bandwidth of a signaling channel (L0 to L3) and of the determined narrowest/widest individual bandwidth for each of the signaling channels available at a signaling node.

11. The apparatus as claimed in patent claim 7 or 8,
characterized in that the evaluation device determines a product of the available individual bandwidths with a predetermined individual bandwidth for each of the signaling channels (L0 to L3) available at a signaling node, and forms a root of the respectively determined products for each of the signaling channels available at a signaling node.

12. The apparatus as claimed in one of patent claims 7 to 11,
characterized in that the assignment device assigns at least one signaling message which is to be transmitted

to the signaling channels (L0 to L3) available at a signaling node (A, B).

FIG 1

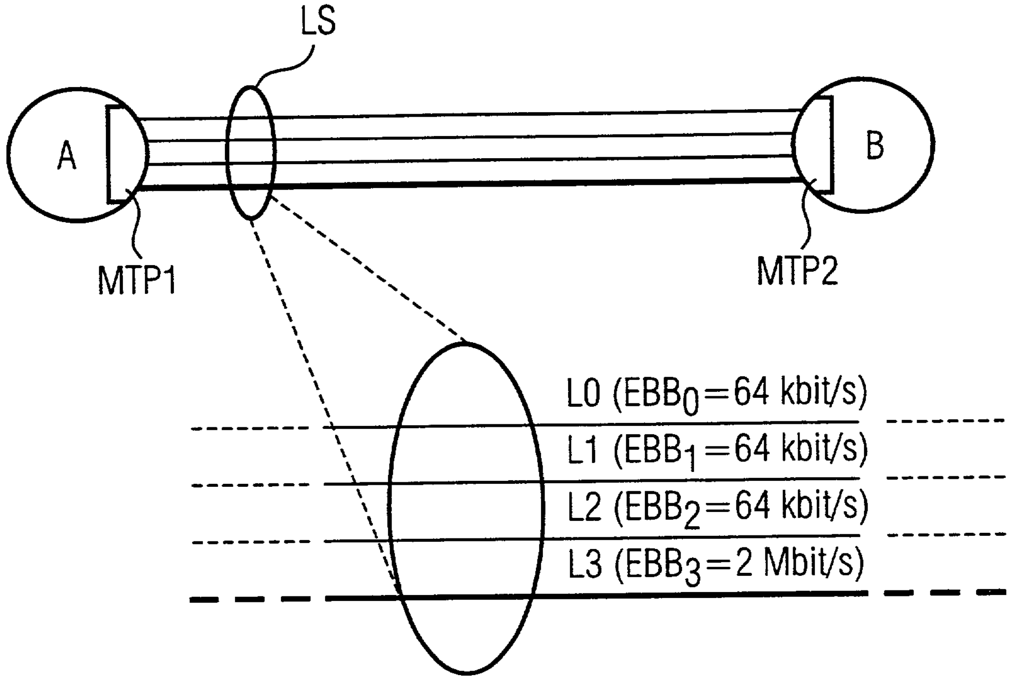
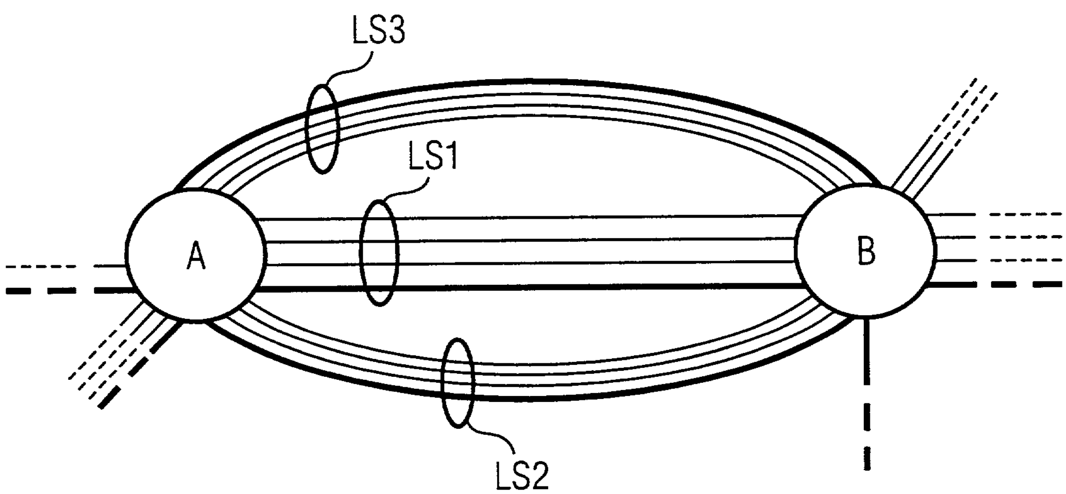

LS
A
B
MTP1
MTP2
L0 (EBB0=64 kbit/s)
L1 (EBB1=64 kbit/s)
L2 (EBB2=64 kbit/s)
L3 (EBB3=2 Mbit/s)

FIG 2


LS3
LS1
A
B
LS2

Declaration and Power of Attorney For Patent Application
Erklärung Für Patentanmeldungen Mit Vollmacht
German Language Declaration

Als nachstehend benannter Erfinder erkläre ich hiermit an Eides Statt:

As a below named inventor, I hereby declare that:

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My residence, post office address and citizenship are as stated below next to my name,

dass ich, nach bestem Wissen der ursprüngliche, erste und alleinige Erfinder (falls nachstehend nur ein Name angegeben ist) oder ein ursprünglicher, erster und Miterfinder (falls nachstehend mehrere Namen aufgeführt sind) des Gegenstandes bin, für den dieser Antrag gestellt wird und für den ein Patent beantragt wird für die Erfindung mit dem Titel:

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled

Vorrichtung und Verfahren zur Verbesserung einer Lastverteilung in einem Signalisierungsnetz

Device and method for improving the load distribution in a signaling network

deren Beschreibung

(zutreffendes ankreuzen)
☐ hier beigefügt ist.
☒ am 17.04.2000 als
PCT internationale Anmeldung
PCT Anmeldungsnummer PCT/DE00/01203
eingereicht wurde und am _______
abgeändert wurde (falls tatsächlich abgeändert).

the specification of which

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☐ is attached hereto.
☒ was filed on 17.04.2000 as
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and was amended on _______
(if applicable)

Ich bestätige hiermit, dass ich den Inhalt der obigen Patentanmeldung einschliesslich der Ansprüche durchgesehen und verstanden habe, die eventuell durch einen Zusatzantrag wie oben erwähnt abgeändert wurde.

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims as amended by any amendment referred to above.

Ich erkenne meine Pflicht zur Offenbarung irgendwelcher Informationen, die für die Prüfung der vorliegenden Anmeldung in Einklang mit Absatz 37, Bundesgesetzbuch, Paragraph 1.56(a) von Wichtigkeit sind, an.

I acknowledge the duty to disclose information which is material to the examination of this application in accordance with Title 37, Code of Federal Regulations, §1.56(a).

Ich beanspruche hiermit ausländische Prioritätsvorteile gemäss Abschnitt 35 der Zivilprozessordnung der Vereinigten Staaten, Paragraph 119 aller unten angegebenen Auslandsanmeldungen für ein Patent oder eine Erfindersurkunde, und habe auch alle Auslandsanmeldungen für ein Patent oder eine Erfindersurkunde nachstehend gekennzeichnet, die ein Anmeldedatum haben, das vor dem Anmeldedatum der Anmeldung liegt, für die Priorität beansprucht wird.

I hereby claim foreign priority benefits under Title 35, United States Code, §119 of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed:

IDNR: 2590 / V: 99-1.00 / B:Val

German Language Declaration

Prior foreign appplications
Priorität beansprucht

Priority Claimed

19917814.3	DE	20.04.1999	☒	☐
(Number)	(Country)	(Day Month Year Filed)	Yes	No
(Nummer)	(Land)	(Tag Monat Jahr eingereicht)	Ja	Nein
			☐	☐
(Number)	(Country)	(Day Month Year Filed)	Yes	No
(Nummer)	(Land)	(Tag Monat Jahr eingereicht)	Ja	Nein
			☐	☐
(Number)	(Country)	(Day Month Year Filed)	Yes	No
(Nummer)	(Land)	(Tag Monat Jahr eingereicht)	Ja	Nein

Ich beanspruche hiermit gemäss Absatz 35 der Zivilprozessordnung der Vereinigten Staaten, Paragraph 120, den Vorzug aller unten aufgeführten Anmeldungen und falls der Gegenstand aus jedem Anspruch dieser Anmeldung nicht in einer früheren amerikanischen Patentanmeldung laut dem ersten Paragraphen des Absatzes 35 der Zivilprozeßordnung der Vereinigten Staaten, Paragraph 122 offenbart ist, erkenne ich gemäss Absatz 37, Bundesgesetzbuch, Paragraph 1.56(a) meine Pflicht zur Offenbarung von Informationen an, die zwischen dem Anmeldedatum der früheren Anmeldung und dem nationalen oder PCT internationalen Anmeldedatum dieser Anmeldung bekannt geworden sind.

I hereby claim the benefit under Title 35. United States Code. §120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code, §122, I acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations, §1.56(a) which occured between the filing date of the prior application and the national or PCT international filing date of this application.

PCT/DE00/01203	17.04.2000	anhängig	pending
(Application Serial No.) (Anmeldeseriennummer)	(Filing Date D, M, Y) (Anmeldedatum T, M, J)	(Status) (patentiert, anhängig, aufgegeben)	(Status) (patented, pending, abandoned)
(Application Serial No.) (Anmeldeseriennummer)	(Filing Date D,M,Y) (Anmeldedatum T, M; J)	(Status) (patentiert, anhängig, aufgeben)	(Status) (patented, pending, abandoned)

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German Language Declaration

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82299 TUERKENFELD	82299 TUERKENFELD
Voller Name des zweiten Miterfinders (falls zutreffend):	Full name of second joint inventor, if any:
Unterschrift des Erfinders — Datum	Second Inventor's signature — Date
Wohnsitz: ,	Residence: ,
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(Supply similar information and signature for third and subsequent joint inventors).